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In re Patent Application of:
ZENG

Serial No. **09/844,347**

Filing Date: **April 27, 2001**

REMARKS

Applicant would like to thank the Examiner for the thorough examination of the present application. The claims have been amended to correct certain inconsistencies as helpfully noted by the Examiner. The arguments supporting patentability of the claims are presented in detail below.

I. The Claims Are Patentable

The Examiner rejected independent Claims 23, 32 and 36 over the published Kocon et al. patent application in view of the Williams et al. patent. The present invention, as recited in independent Claim 23, for example, is directed to a MOSFET comprising a semiconductor layer having a trench therein, a gate conducting layer in a lower portion of the trench, and a dielectric layer is in an upper portion of the trench. Source regions are adjacent the dielectric layer. Source/body contact regions are laterally spaced apart from the trench and are recessed within the semiconductor layer and non-interruptively contact the source regions. Independent Claim 23 further recites that the dielectric layer extends outwardly from the semiconductor layer, the source regions and the source/body contact regions, and the outwardly extending dielectric layer has sidewalls aligned with sidewalls of the trench.

The MOSFET is advantageously formed with the upper portion of the dielectric layer in the trench extending outwardly from the semiconductor layer, the source regions, and the source/body contact regions - wherein sidewalls of the outwardly extending dielectric layer are aligned with sidewalls of the trench. This feature of the present

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invention advantageously allows spacers to be formed laterally adjacent the outwardly extending dielectric layer, which are then used as self-aligned masks for implanting dopants into the semiconductor layer.

Independent Claim 32 is similar to independent Claim 23, and further recites a source electrode on the source regions and on the dielectric layer. At least one conductive via is between the source electrode and the source/body contact regions and extends through the source regions. Independent Claim 36 is also similar to independent Claim 23, and further recites that the source regions include an opening therein, and the source/body contact regions are exposed by the opening in the source regions.

Referring now to the published Kocon et al. patent application, and in particular to FIG. 31, the illustrated MOSFET includes a semiconductor layer 103 having a trench 204 therein, a gate conducting layer 205 in a lower portion of the trench, and a dielectric layer 207 above the trench. Source regions 201 are adjacent the dielectric layer. Source/body contact regions 211 are laterally spaced apart from the gate conducting layer and non-interruptively contact the source regions 201. The dielectric layer 207 extends outwardly from the semiconductor layer 103, the source regions 159 and the source/body contact regions 160.

As correctly noted by the Examiner, Kocon et al. fails to disclose that the outwardly extending dielectric layer 207 has sidewalls aligned with sidewalls of the trench 204. The Examiner cited Williams et al. as disclosing this feature of the claimed invention. In particular, reference is made to FIGS. 11E and 15D. In FIG. 11E, for example, the

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thick oxide layer 116 is over the trench 104, and extends outwardly therefrom - however, sidewalls of the thick oxide layer 116 are not aligned with the sidewalls of the trench. Instead, the sidewalls of the outwardly extending thick oxide layer 116 are rounded or curved so that they slope inwards toward a center of the trench 104.

In fact, FIG. 15D nor any of the other figures in Kocon et al. illustrate the sidewalls of the thick oxide layer being aligned with the sidewalls of the trench. Reference is directed to paragraph 106 in the published Kocon et al. patent application, which provides:

"... Next, the exposed surface of the polysilicon gate 112 is oxidized to form a thick oxide layer 116 overlying the gate 112 (FIG. 11C). Thick oxide layer 116 protects gate 112 from subsequent etches and "embeds" gate 112 in the trench 104 so that gate 102 will not short to the (source) metal that will overlay the trench 104 in a completed device. . . . In conventional processes the oxide used to embed the gate is not localized or "self-aligned" to the trench region, but may extend on to or across the mesas."
(Emphasis added.)

First, layer 116 is formed by oxidation. As noted above, the surface of the polysilicon gate 112 is oxidized. The curved or rounded sides of the thick oxide layer 116 appear to be formed based upon a "parabolic stage" of oxidation. That is, the relationship of the oxide thickness, growth rate, and time causes the oxide layer 116 to take the shape of a parabola - which results in the sidewalls being curved or rounded.

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The purpose of the thick oxide layer 116 is to prevent the gate 112 from contacting the metal layer contact 122. Consequently, there is no need for the sidewalls of the thick oxide layer 116 to be aligned with sidewalls of the trench 104. Moreover, the Williams et al. patent fails to teach or suggest that the sidewalls of the thick oxide layer 116 should be aligned with the sidewalls of the trench 104.

In sharp contrast, the Applicant noted a need for the sidewalls of the outwardly extending dielectric layer to be aligned with sidewalls of the trench. This feature of the present invention advantageously allows spacers to be formed laterally adjacent the outwardly extending dielectric layer, which are then used as self-aligned masks for implanting dopants into the semiconductor layer. Therefore, even if the references were combined as suggested by the Examiner, the claimed invention is still not produced. Accordingly, it is submitted that independent Claim 32 is patentable over the published Kocon et al. patent application in view of the Williams et al. patent.

Independent Claims 32 and 36 are similar to independent Claim 23, and it is submitted that Claims 32 and 36 are also patentable over the published Kocon et al. patent application in view of the Williams et al. patent. In view of the patentability of the independent claims as discussed above, it is submitted that their dependent claims, which recite yet further distinguishing features, are also patentable over the prior art. Thus, these dependent claims require no further discussion herein.

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CONCLUSION

In view of the amendments to the claims and the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,


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CERTIFICATE OF FACSIMILE TRANSMISSION

I HEREBY CERTIFY that the foregoing correspondence has been forwarded via facsimile number 703-872-9306 to the Commissioner for Patents on this 6 day of January, 2005.

